THE WOODVILLE RECHARGE BASIN AQUIFER PROTECTION STUDY

PROGRESS REPORT

The Board of Leon County Commissioners conceived and implemented The Woodville Aquifer Protection Study to protect water quality within the Woodville Recharge Basin (WRB). This project is funded through a U.S. Environmental Protection Agency (EPA) grant. All of the water quality problems associated with groundwater in the WRB are direct results of contamination from human wastewater coming from septic systems (OSDS) or wastewater sprayfields (SESF). The Floridan Aquifer in the WRB, south of the Cody Scarp, is vulnerable to contamination from anything that is poured on the surface of the sandy soils, usually less than 20 feet thick, that lies over the unconfined Floridan Aquifer. This area is not suited for waste water disposal. Increasing numbers of OSDS within the WRB pose a significant threat to future ground water quality. OSDS effluent can flow quickly from the unconsolidated surficial sands into the Upper Floridan Aquifer. Private domestic wells drawn from the Upper Floridan Aquifer can receive varying amounts of OSDS effluent. As the number of residents within the WRB increases, OSDS of the Floridan Aquifer will likely increase and negatively impact both domestic wells and surrounding springs. A regional solution to this problem, such as a waste water system that disposes of effluent outside the WRB, is warranted.

Completed Work Efforts and Associated Findings:

Phase I entailed a compilation and analysis of existing studies and the identification of areas within the WRB where the aquifer is most vulnerable to contamination. Most aquifer in the WRB, south of the Cody Scarp, was found to be vulnerable.

Phase II addressed data gaps identified in Phase I, among them:

(1) **There was general lack of surface water quality data throughout the WRB.** Most of the surface waters and springs within the WRB had good water quality.
(2) **There was general lack of ground water quality data throughout the WRB.** Domestic wells tended to be less than 100 feet deep. Contaminated wells showed no discernable pattern. Contamination was often traceable to a near by surface impact, such as an OSDS. Examination of monitoring well data at the SESF revealed that the effluent sinks rapidly into deeper limestone units. The nitrate plume is at a depth of approximately 125 feet at the southern boundary of the SESF.
(3) **The direction of groundwater flow.** A piezometric mapping effort conducted by the County's GIS Division and McGlynn Labs Inc., using recently acquired LIDAR data, found that groundwater generally flows southwest through the

WRB. This finding is in general agreement with the NWFWMD's earlier study. This mapping does not show or represent cavernous conduit flow.

(4) **There was lack of knowledge of the karst features within the WRB.** It was thought that the sandy soils would fill in caverns and prevent conduit flow. Potential karst features were identified by the County's GIS Division utilizing the LIDAR data and an algorithm. These features were then located and evaluated. Many of these karst features contained submerged caverns. Some caverns have been verified by diving. Extensive cavern systems underlie much of the WRB. The water quality in the karst features within the WRB was generally good. The water in open karst features, southwest of the SESF, had elevated nitrates.

(5) **The impact of the SESF on the St. Marks Rise (spring).** Groundwater with high nitrates, likely indicative of SESF effluent, was not found in the St. Marks River or St. Marks Rise, indicating that SESF effluent does not flow via subterranean routes into the St. Marks basin. Nitrate concentrations in the St. Marks Rise, a higher magnitude spring than Wakulla, were significantly lower than the nitrate concentrations at Wakulla Springs.

(6) **The impact of the SESF on Wakulla Springs.** The SESF appears to contaminate the shallow surficial sand aquifer only on the SESF property and areas immediately thereto. Karst features, open to the aquifer, between the SESF and Wakulla Springs had nitrate concentrations significantly elevated above background levels. When nitrate concentrations for these karst features are plotted, a dilution factor of approximately 10 percent per mile was calculated. This, together with the Piezometric map and the lack of nitrates in the St. Marks Rise indicates that the direction of groundwater flow from the SESF is probably towards Wakulla Springs. Wakulla Springs is enriched with nitrates. The enhanced growth of submerged aquatic vegetation (SAV) and aquatic algae at the spring are probably the result of phosphate enrichment. Nitrogen/Phosphorus ratios indicate that Wakulla Springs is phosphate limited. While nitrates derive from wastewater inputs to the aquifer (SESF and OSDS), phosphates likely originate from urban storm water entering open karst features. These phosphates are probably rapidly transported via subterranean conduits to the spring. Lake Lafayette, Lake Jackson and Lake Munson, which contain open karst features, are likely sources of phosphate loading.

(7) **The status of the SESF operating permit.** The SESF within the WRB is currently operating on a permit extension. Violations of the current permit may cause the SESF to be fined by the Florida Department of Environmental Protection (FDEP).

Challenges:

Rather than commit the limited resources of the WRB study in a careless manner we decided to conduct an intermediate survey, Phase II, of existing domestic wells, karst features and the SESF permit status. This consumed some time. If we had proceeded to drill monitoring wells immediately after Phase I we would have missed the suspected nitrate plume because it appears to be far deeper in the aquifer than suspected.

It will be necessary to drill wells, deeper than anyone suspected, in order to reach the suspected plume. The SESF effluent, as well as OSDS effluent, which are more dense than groundwater, sink rapidly into deep limestone units. The plume probably drops in depth as it moves southwest across the WRB. The cost of each deep well is over ten thousand dollars. The installation of a comprehensive grid of deep wells would consume the bulk of our funding. Following BOCC direction not to duplicate or replicate research efforts in the two studies, it was decided to coordinate the installation of deep wells with the United States Geological Survey (USGS) (funded by the City of Tallahassee). This grid of wells (south of the SESF) is currently being installed. First a set of three (USGS), second a set of four (USGS) and then up to seven wells (MLI) will sequentially follow the suspected plume south through Leon County (Est. cost $140,000). These deep wells should provide an adequate coverage of the WRB. Wells will be sampled separately. We will generate our own data, as will the USGS. Waiting for the USGS to get started, the wells are currently being installed, consumed some time.

A comprehensive diffuse groundwater flow study will be run, sharing wells, with the USGS. The USGS wish to utilize our domestic wells. Since there are some areas lacking coverage additional piezometric wells will be installed, as needed, in coordination with the USGS (sharing costs). This final diffuse flow groundwater survey will provide data for some areas of the WRB that lacked data in previous surveys.

Savings, due to sharing expenses for well installation allows other problems in the WRB to be investigated, when we would have exhausted our budget installing wells.

A comprehensive analysis of OSDS, atmospheric deposition, modeling, land use and basin management planning can proceed. We will have the funds to comprehensively address these areas of concern.

Dye studies will define the cavernous underground conduit flow. The examination of the karst features within the WRB was time consuming. We now have the funds to discern the direction of conduit groundwater flow, which is often different from diffuse groundwater flow, both of which seem to occur in the WRB. Diffuse groundwater flow, measured with Piezometric wells, does not address conduit flow that occurs when the groundwater flows in caverns within the lime rock that underlies the shallow surficial sandy soil of the WRB. Conduit flow is much more rapid than diffuse groundwater flow in which water filters slowly through the soil. Water flowing in conduits lacks the treatment it gets passing through the soil. Conduits, or underground water filled caverns have been identified within the WRB.

Science is the study of the unknown. One often finds the unexpected, like the complex hydrogeology of this portion of Leon County, as well as its vulnerability to degradation. The true extent of contamination was not anticipated. No one thought that contamination could reach so deep into the aquifer. The cost of reaching these depths, as well as the lack of data was not anticipated. Our tasks have taken longer than anticipated. We

already have important findings. This study is important to the citizens of Leon County. Please allow us to continue.